

2.4 ENVIRONMENTAL HAZARD INFORMATION

The chemicals in lithography are divided into three groups: (1) discrete organic chemicals, (2) petroleum products, and (3) inorganic chemicals. While the assessment process is the same for all three groups, the methodology used to provide estimates of the aquatic toxicity of the chemicals varies.

2.4.1 Methodology

The EPA Environmental Effects Branch uses a standard assessment process (see Appendix A) for assessing the hazards of chemicals to the aquatic environment. The process has been described in several publications, both inside and outside the Agency. A summary of the hazard assessment process and references are in Appendix A. The methodology involves the development of a standard hazard profile for each chemical consisting of three acute toxicity values and three chronic values for aquatic species. The standard hazard profile consists of the following toxicity values:

- Fish acute value (usually a fish 96-hour LC_{50} value)
- Aquatic invertebrate acute value (usually a daphnid 48-hour LC_{50} value)
- Green algal toxicity value (usually an algal 96-hour EC_{50} value)
- Fish chronic value (usually a fish 28-day early life stage no effect concentration (NEC))
- Aquatic invertebrate chronic value (usually a daphnid 21-day NEC)
- Algal chronic value (usually an algal 96 hour NEC value for biomass)

For the acute values, the LC_{50} (mortality) (EC_{50}) (effects) refers to the concentration that results in 50 percent of the test organisms affected at the end of the specified exposure period. The chronic values represent the concentration of the chemical that results in no statistically significant effects on the test organism following a chronic exposure.

The toxicity values may be obtained from the results of standard toxicity tests reported to the Agency, published in the literature, or estimated using predictive techniques. For this study, discrete organic chemicals were assessed using predictive equations called Structure Activity Relationships (SARs) to estimate the inherent toxicity of these chemicals to aquatic organisms. The literature sources that were searched to confirm these estimates are located in the Administrative Record. No data were found to conflict with these estimates. The toxicity values are for the discrete chemical only; interactions between chemicals within a formulation are not considered.

Although measured values are preferred, in the absence of test data, SAR estimates, if available for the chemical class, can be used. The predictive equations, i.e., quantitative structure-activity relationships, are used in lieu of test data to estimate toxicity values for aquatic organisms within a specific chemical class. The equations are derived from correlation and linear regression analysis based on measured data, however, the confidence interval associated with the equation is not used to provide a range of toxicity values. Thus, the hazard profile may consist of only measured data, only predicted values, or a combination of both. Also, the amount of data in the hazard profile may range from a minimum of one acute or chronic value to the full compliment of three acute values and three chronic values.

Some petroleum products such as mineral spirits and solvent naphtha are mixtures and do not lend themselves readily to the standard hazard assessment process using SARs. The chemical constituents and the percentage of each in the mixture varies. The constituents in these products include linear and branched paraffins, and cyclic paraffins with the total number of carbons varying between 5 and 16. The toxicity of the petroleum products were determined by estimating the toxicity of each individual constituent. Absent adequate description and characterization, the assumption is made that each component is present as an equal percentage in the product and the geometric mean of the range of estimates provides the best estimate of the toxicity. These assumptions may not be representative of the mixture currently on the market, but can be used for screening level hazard assessments. The toxicity of the individual components of the petroleum products is based on tests using pure samples. The potential by-products or impurities of petroleum distillation that are typically found in these mixtures were not incorporated in this hazard assessment.

The concentration of concern was also derived for each chemical. This value is derived by dividing the lowest of the three chronic values by a factor of 10. If the discharge of a chemical to the aquatic environment results in a concentration equal to or greater than the concern concentration set, then the chemical would be hazardous to aquatic organisms.

Assessment factors were used to incorporate the concept of uncertainty into the concern concentrations. Assessment factors account for laboratory tests versus field data and measured versus estimated data, as well as species sensitivity. In general, if only one toxicity value is available, there is a large uncertainty about the applicability of this value to other organisms in the environment and a large assessment factor, i.e., 1000, is applied to cover the breadth of sensitivity known to exist among and between organisms in the environment. Conversely, the more information that is available results in more certainty about the toxicity values, and requires the use of a smaller assessment factor. For example, if toxicity values are derived from field tests, then an assessment factor of 1 is used. Assessment factors of 1, 10, 100 and 1000 are generally applied for chronic risk depending on the amount and type of toxicity data in the hazard profile.

2.4.2 Results

The results of the estimated aquatic toxicity determinations are summarized in Table 2-5. The chemicals are listed alphabetically. No valid published literature were found to conflict with the estimated values. The full literature searches conducted are available in the Administrative Record. For each chemical, the estimated toxicity values in mg/L (ppm) for acute and chronic effects of fish, daphnid and algae are given. The last column shows the concern concentration set for the chemical in the water. Based on the methodology described in the previous section, the hazard potential of the various products are discussed in the following paragraphs.

Mineral Spirits

Mineral spirits consist of linear and branched paraffins and cyclic paraffins. Based on the information provided, the assessment was based on the estimated toxicity for n-hexane and ethylcyclohexane. The linear form of n-hexane is approximately two times more toxic than cyclic hexane. The lowest chronic value for n-hexane is 0.004 mg/L for fish and the lowest chronic value for ethylcyclohexane is 0.09 mg/L for fish.

Naphtha Solvents

The monomers associated with the various naphtha mixtures include linear and branched paraffins, cyclic paraffins and aromatics such as naphthalene. The carbon chain lengths vary from product to product and span the range from 5 to 16.

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Table 2-5. Estimated Aquatic Toxicity Values of Blanket Wash Chemicals Based on SAR Analysis (mg/L)

Chemical	Acute Toxicity	Acute Toxicity			Chronic Toxicity			Concern Concentration
		Fish	Invert	Algal	Fish	Invert	Algal	
Alcohols, C ₁₂ -C ₁₆ , ethoxylated		1.0	1.0	1.0	0.1	0.1	0.1	0.01
Benzene, 1,2,4-trimethyl		0.97	1.2	0.84	0.17	0.15	0.28	0.02
Benzenesulfonic acid, dodecyl		2.6	2.6	0.007	0.4	0.4	0.005	0.001
Benzenesulfonic acid, dodecyl-, compounds with 2-aminoethanol		2.6	2.6	30.0	0.4	0.3	10.0	0.03
Benzenesulfonic acid, dodecyl-, compounds with 2-propanamine		2.6	2.6	0.007	0.4	0.4	0.005	0.001
Benzenesulfonic acid, (tetrapropenyl)-, compounds with 2-propanamine		2.6	2.6	0.007	0.4	0.4	0.005	0.001
Benzenesulfonic acid, C ₁₀ -C ₁₆ -alkyl derivatives, compounds with 2-propanamine		0.75	0.75	0.002	0.12	0.12	0.001	0.001
Butyrolactone		140	>1000	>1000	14	>100	>100	1.4
Cumene		2.1	2.6	1.8	0.37	0.28	0.48	0.03
Diethanolamine		>1000	220	130	>100	22	12.8	1.3
Diethylene glycol monobutyl ether		>1000	>1000	860	140	40	40	4.0
Dimethyl adipate		140	>1000	11	14	>100	8.4	0.84
Dimethyl glutarate		245	>1000	18	24	>100	13.6	1.4
Dimethyl succinate		165	>1000	12.5	16	>100	9.3	0.9
Dipropylene glycol monobutyl ether		400	410	250	50	17	19	1.7
Dipropylene glycol methyl ether		>1000	>1000	>1000	184	149	877	14.9
Distillates (petroleum), hydrotreated, middle		1.8	2.2	1.5	0.31	0.23	0.38	0.02
Ethoxylated nonylphenol		2.0	2.0	2.0	0.2	0.2	0.2	0.001 ¹
Ethylenediaminetetraacetic acid, tetrasodium salt		430	100	3.0	10.0	23.0	0.88	0.09
Fatty acids, C ₁₆ -C ₁₈ methyl esters		*2	*	*	*	*	*	*
Fatty acids, C ₁₆ -C ₁₈ and C ₁₈ -unsatd, compounds with diethanolamine		140	120	70	20	20	40	2.0
Fatty acids, tall oil, compounds with diethanolamine		160	200	100	20	30	20	2.0
Hydrocarbons, terpene processing by-products		0.86	1.1	0.76	0.16	0.14	0.27	0.01
d-Limonene		0.81	1.0	0.72	0.15	0.14	0.27	0.01
Linalool		45	50	32	6.1	3.0	4.1	0.3
Mineral spirits (light hydrotreated)		1.8	2.2	1.5	0.31	0.23	0.38	0.02
N-Methylpyrrolidone		1000	1000	1000	100	370	260	30
Naptha (petroleum), hydrotreated heavy		*	*	*	0.006	0.013	0.03	0.001
Nerol		28	31	20	4.0	2.1	3.0	0.21
Oxirane, methyl, polymer with oxirane, monodecyl ether		16	16	20	1.6	1.6	5.0	0.16
2-Pinanol		31	35	22	4.4	2.3	3.2	0.23
Pinols		170	180	112	21	8.5	10.0	0.85
Polyethoxylated isodecyloxypropylamine		13	13	13	1.3	1.3	1.3	0.13
Poly(oxy-1,2-ethanedivyl), α-hexyl-ω-hydroxy		320	320	300	32	32	40	3.2

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Chemical	Acute Toxicity			Chronic Toxicity			Concern Concentration
	Fish	Invert	Algal	Fish	Invert	Algal	
Propanoic acid, 3-ethoxy-, ethyl ester	60	650	4.7	6.0	70	3.5	0.35
Propylene glycol	>1000	>1000	>1000	>100	>100	>100	>10
Propylene glycol monobutyl ether	>1000	>1000	>1000	>100	>100	>100	>100
Sodium bis(ethylhexyl) sulfosuccinate	3	3	3	5	5	3	0.05
Sodium hydroxide	>1000	>1000	>1000	>100	>100	>100	>10
Sodium xylene sulfonate	>1000	>1000	>1000	>100	>100	>100	>10
Solvent naphtha (petroleum), heavy aromatic	0.6	0.77	0.55	0.12	0.12	0.23	0.012
Solvent naphtha (petroleum), light aliphatic	3.3	3.9	2.6	0.53	0.36	0.58	0.036
Solvent naphtha (petroleum), light aromatic	5.5	6.5	4.4	0.88	0.59	0.93	0.059
Solvent naphtha (petroleum), medium aliphatic	*	*	*	0.001	0.002	0.005	0.001
Sorbitan, mono-9-octadecenoate	20	20	20	3	3	5	0.3
Sorbitan, monododecanoate, poly(oxy-1,2-ethanediyl) derivatives	20	20	20	3	3	3	0.3
Sorbitan, monolaurate	11	20	0.93	2	3	0.69	0.07
Sorbitan, tri-9-octadecenoate, poly(oxy-1,2-ethanediyl) derivatives	20	20	20	3	3	3	0.3
Soybean oil, methyl ester	*	*	*	*	*	*	*
Soybean oil, polymerized, oxidized	*	*	*	*	*	*	*
Stoddard solvent	1.8	2.2	1.5	0.31	0.23	0.38	0.02
Tall oil, special	*	*	*	*	*	*	*
α -Terpineol	33	37	24	4.7	2.4	3.3	0.24
Terpinolene	0.81	1.0	0.72	0.15	0.14	0.26	0.014
Tetrapotassium pyrophosphate	>100	>100	<1.0	>10	>10	0.06	0.006
Xylene	3.5	4.1	2.8	0.57	0.40	0.64	0.04

¹ There is a concern that this chemical may degrade to nonylphenol. Evidence suggests that nonylphenol may be an endocrine disrupter. Until such time as conclusive evidence resolves this issue, the concern concentration is set at 0.001 mg/L.

² * = No effects expected in a saturated solution during prescribed exposure period.

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For the purpose of an overall assessment, the listed chemicals can be ranked according to the estimated chronic value. This hazard ranking, developed by the EPA Environmental Effects Branch, is based on scoring the chemicals as High, Moderate or Low concern for chronic effects according to the following criteria:

≤ 0.1 mg/L	High
≥ 0.1 to ≤ 10 mg/L	Moderate
> 10 mg/L	Low

See Appendix A for the basis and citations supporting these criteria and hazard rankings.

The results of this ranking are summarized in Table 2-6. The chemicals are ranked from the highest hazard potential to the lowest, based on lowest of the three estimated chronic values for each chemical. The petroleum products are rated as high hazard to aquatic organisms and the concern is for chronic effects. This relative ranking of toxicity provides guidance to the selection and use of chemicals that are less hazardous to aquatic organisms. In addition to this ranking system used by OPPT, other aquatic hazard ranking systems exist that could be applied.

Table 2-6. Environmental Hazard Ranking of Blanket Wash Chemicals¹

Chemical	CAS Number	Lowest Chronic Value (mg/L)	Hazard Rank
Ethoxylated nonylphenol	various given		H ²
Benzenesulfonic acid, C ₁₀ -C ₁₆ -alkyl derivatives, compounds with 2-propanamine	68584-24-7	0.001	H
Solvent naphtha (petroleum), medium aliphatic	64742-88-7	0.001	H
Benzenesulfonic acid, dodecyl-	27176-87-0	0.005	H
Benzenesulfonic acid, dodecyl,(tetrapropenyl)-, compounds with 2-propanamine	157966-96-6	0.005	H
Benzenesulfonic acid, dodecyl-, compounds with 2-propanamine	26264-05-1	0.005	H
Naphtha (petroleum), hydrotreated heavy	64742-48-9	0.006	H
Alcohols, C ₁₂ -C ₁₅ , ethoxylated	68131-39-5	0.1	H
Solvent naphtha (petroleum), heavy aromatic	64742-94-5	0.12	M
Hydrocarbons, terpene processing by-products	68956-56-0	0.14	M
d-Limonene	5989-27-55	0.140	M
Terpinolene	586-62-95	0.140	M
Tetrapotassium pyrophosphate	7320-34-57	0.140	M
Benzene, 1,2,4-trimethyl	95-63-69	0.150	M
Stoddard solvent	8052-41-38	0.230	M
Mineral spirits, light hydrotreated	64742-47-8	0.23	M
Distillates (petroleum), hydrotreated. middle	64742-46-7	0.23	M
Cumene	98-82-8	0.28	M

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Chemical	CAS Number	Lowest Chronic Value (mg/L)	Hazard Rank
Benzenesulfonic acid, dodecyl-, compounds with 2-aminoethanol	26836-07-7	0.30	M
Solvent naphtha (petroleum), light aliphatic	64742-89-8	0.36	M
Xylene	1330-20-7	0.4	M
Sodium bis(ethylhexyl) sulfosuccinate	577-11-7	0.5	M
Solvent naphtha (petroleum), light aromatic	64742-95-6	0.59	M
Sorbitan, monolaurate	5959-89-7	0.69	M
Ethylenediaminetetraacetic acid, tetrasodium salt	64-02-8	0.88	M
Polyethoxylated isodecylxypropylamine	68478-95-5	1.3	M
Oxirane, methyl, polymer with oxirane, monodecyl ether	37251-67-5	1.6	M
Nerol	106-25-2	2.1	M
2-Pinanol	473-54-1	2.3	M
α -Terpineol	98-55-5	2,4	M
Sorbitan, mono-9-octadecenoate	1338-43-8	3.0	M
Linalool	78-70-6	3.0	M
Sorbitan, tri-9-octadecenoate, poly(oxy-1,2-ethanediyl) derivatives	9005-70-3	3.0	M
Sorbitan, monododecanoate, poly(oxy-1,2-ethanediyl) derivatives	9005-64-5	3.0	M
Propanoic acid, 3-ethoxy-, ethyl ester	763-69-9	3.5	M
Dimethyl adipate	627-93-0	8.4	M
Pinols	72402-00-7	8.5	M
Dimethyl succinate	106-65-0	9.3	M
Diethanolamine	111-42-2	13	L
Dimethyl glutarate	1119-40-0	13	L
Butyrolactone	96-48-0	14	L
Dipropylene glycol monobutyl ether	29911-28-2	17	L
Propylene glycol monobutyl ether	5131-66-8	20	L
Fatty acids, C ₁₆ -C ₁₈ , compounds with diethanolamine	68002-82-4	20	L
Fatty acids, tall oil, compounds with diethanolamine	61790-69-0	20	L
Poly(oxy-1,2-ethanediyl), α -hexyl- -hydroxy	31726-34-8	32	L
Diethylene glycol monobutyl ether	112-34-5	40	L
Propylene glycol	57-55-6	100	L
Sodium xylene sulfonate	1300-72-7	100	L

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Chemical	CAS Number	Lowest Chronic Value (mg/L)	Hazard Rank
Sodium hydroxide	1310-73-2	100	L
N-Methylpyrrolidone	872-50-4	100	L
Dipropylene glycol methyl ether	34590-94-8	149	L
Tall oil, special	68937-81-5	* ³	L
Fatty acids, C ₁₆ -C ₁₈ , methyl esters	67762-38-3	*	L
Soybean oil, methyl esters	67784-80-9	*	L
Soybean oil, polymerized, oxidized	68152-81-8	*	L

¹ Ranking based on the lowest estimated chronic value; H = High, M = Moderate, L = Low.

² There is a concern that this chemical may degrade to nonylphenol. Evidence suggests that nonylphenol may be an endocrine disrupter. Until such time as conclusive evidence resolves this issue, a "high" aquatic hazard ranking is automatically assigned whenever a compound contains nonylphenol.

³ * = No effects in a saturated solution during the prescribed test duration.